Mosquito Classification Method Based on Convolutional Neural Networks

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Abstract. Zika and Dengue are viruses transmitted to humans by infected mosquitoes (Aedes Aegypti), often found in warm and humid regions. To prevent outbreaks, public health agencies have an important role in locating and eliminating mosquito breeding sites. Among different approaches, mining data from social networks may improve knowledge of locations with highest concentration of reported cases. There are solutions analyzing text from networks such as twitter. But here we propose a new approach using images from Instagram and Facebook. For this purpose, we use two customized deep Convolutional Neural Networks trained on real images. The first detects XX objects commonly used for vector reproduction such as tires and bottles with XX% precision. The second classifies a mosquito as Culex (common mosquito) or Aedes Aegypti (Zika vector) with XX% accuracy. Results indicate that using both networks can improve the effectiveness of existing social network mining strategies such as the VazaZika project.

Keywords: Convolutional Neural Networks, Zika Virus, Social Networks

1 Introduction

The vast number of insect species is a very difficult challenge for insect identification. Several diseases (such as Dengue Fever, Dengue Hemorrhagic Fever, Chikungunya and Zika) are transmitted through Aedes aegyptis mosquitoes.

Over the years, Dengue has become a big problem for global public service, affecting mainly tropical countries. The reason is the warm and humid weather which forms ideal conditions for mosquito proliferation.

Zika may cause a congenital malformation known as microcephaly [7]. When this happens, babies are born with abnormally small heads because the virus diverts a key protein necessary or neural cell division - a crucial part of brain structure building. The diversion happens as part of an immune response (as the body tries to fight off infection) but, as a result, neural progenitor cells (building blocks of the brain) do not divide to form brain structure as they otherwise would.

Several cases of dengue contamination are registered every year in Brazil - there was around 1,600,000 cases in 2015 [1].

Medical literature data has shown that, in 2017, treatment costs in Brazil was around US$ 300 mi for Dengue; U$ 73.6 mi for Chikungunya; and U$ 91.1 for Zika virus consequences. For all these diseases, vector control is a powerful form of prevention that, unfortunately, has not been used with all its potential.

Aedes aegypti is entirely adapted to urban environment, finding in households the necessary conditions for its development. Hence, the vector disseminates different viral diseases and, for this reason, government agencies have been focused on vector control.

An approach to locate mosquito breeding and activity sites is to mine data from social networks. Based on users posts in platforms such as Twitter, pest control authorities may retrieve information as geo-localization, amount of reported cases, etc. In this context, the VazaZika project [REF][CHECK IF REVIEW IS DOUBLE-BLIND] provides a platform where users can report cases from which a geographical map containing the highest concentration of mosquitoes can be inferred.

To widen the analysis and extend the amount of collected information, we propose the analysis of posts from image-focused social networks such as Instagram and Facebook. For this purpose, we use Deep Convolutional Neural Networks trained for two tasks. One is more general and performs the detection of objects commonly used by mosquitoes for egg deposition, eg., tires, bottles, jars, etc. The second identifies whether a mosquito belongs to the class culex (common mosquito) or Aedes Aegypti (vector of Zika and other viruses). To the extend of our knowledge, no work has been presented where Convolutional Neural Networks have been used to similar goal. We argue that our solution, working in tandem with the VazaZika project, has potential to improve the effectiveness of health agencies actions, reducing the number of cases among the population.

2 Related work

Many works realized with propose identify and classify bug and mosquitoes, this problem is very old, [5] proposed a predict model for mosquito habitat using remotely sensed data with techniques for aerial photographic identification (remotely sense).

Recently, we see in [10] that authors used a SVM and Artificial Neural Network (in separate),for the features extraction realized with help in the software as ABIS and DAISY. The features analysis is area, perimeter, holes' number, eccentricity and others. [1] provides characteristic descriptions of some insects and statistical analysis of the data. The characteristic is abdomen, thorax, head and others. The image filtered and they realized segmentation for the classification.

In the literature see propose to method than identify mosquito breeding sites using drone images. The authors [9] analyses and extract features the video

[1] www.portalsaude.saude.gov.br

generate where is located in map the position to suspected breeding sites and the information send a generated 3D meshes for inspectors.

A new algorithm for segmenting and counting Aedes Aegypti eggs used in [4]. This papers introduce a propose using k-means clustering algorithm combination with image processing techniques (color systems exploration). For this purpose, the original RGB image converted into a HSV image, for the extract features in the image.

In the article [2] analysis the mosquito and classify which are Dengue mosquitoes. The papers present a decision tree showing the work to be carried out , where the principal objective is identify female mosquitoes. He was uses a preprocessing (gray scale transformation, blurred image and Equalization Histogram) for analyses. The input image feature was extract and the information used for classify mosquito using techniques of DIP.

SVM for classification of mosquitoes used for [3], where the features used in the papers was the color and morphological. The picture segmentation utilized for separate mosquito and background, where the sobel filter applied for edge detection. It was report, the authors not considered wings and arms to mosquito because the elements retired in the segmentation process.

With recent advances in neural network many works with this motif are being developed. In [6], the authors using artificial neural network for automated identification of mosquito, they used Fourier transform for to classification apply in wing-beat waveform. The authors [8] propose a novel method based on convolution neural networks for mosquito larva classification, the article used Alexnet architecture for the deep model.

3 Materials and Methods

3.1 Aedes Aegypti Egg Laying Objects Database – AELO

3.2 Aedes Aegypti vs Culex Database – AAvC

4 Results and Discussion

5 Conclusion

6 Acknowledgments

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